

REMARKS/ARGUMENTS

Review and reconsideration on the merits are requested.

This Amendment is being filed pursuant to a telephone conference with Examiner Mutschler. As explained during that phone conference, the claims are hereby amended to place claim 29 in independent form, i.e., the plating solution has been defined as being devoid of both levelers and brighteners. As a result of this amendment, the art rejections at paragraphs 4 and 5 of the Office Action and the double patenting rejection at paragraph 9 are obviated. This response is accompanied by a Declaration under 37 CFR 1.132 by Dr. E. Jennings Taylor in which Dr. Taylor attests that the Martin et al. patent cited for the rejections does not teach plating solutions that are devoid of both brighteners and levelers. This response is also accompanied by a Terminal Disclaimer relative to the double patenting rejection at paragraph 10.

Each of the remaining rejections is premised on the teachings of Martin et al and, more particularly, claim 4 of the Martin et al. patent. That claim defines the plating solution as being produced by combining sulfuric acid, copper sulfate and chloride ions. The Office takes the position that this claim teaches plating solutions devoid of brighteners and levelers. However, this is not the case. In fact, Martin et al. teaches a "standard copper plating bath." That bath contains a PPR carrier and an unidentified PPR additive. Based upon this teaching and the description of the bath as being a "standard bath" the Office cannot properly conclude that Martin et al. teaches or suggests the method of claim 1 wherein the bath is defined as devoid of levelers and brighteners.

In the attached affidavit of Dr. Taylor, he provides further background and testimony on this issue. It is clear from Dr. Taylor's Declaration that the use of brighteners or levelers would be the norm in designing a plating solution. Martin et al.'s express reference to the plating solution as "a standard copper plating bath" would suggest to anyone skilled in the art that at least one of these two additives is present. These additives have serious shortcomings. As noted in the Declaration, they add cost to the process but more importantly, as Dr. Taylor notes, they must be carefully monitored. When coating holes and recesses as small as those encountered in semiconductor devices having high aspect ratios, a deviation in any variable can have detrimental effects on the product. Eliminating the variable associated with levelers and brighteners in

accordance with the invention, improves the efficacy of the manufacturing process. In summary each of the remaining art rejections should fail. Claim 4 is simply a claim. It does not teach a person of ordinary skill in the art to plate high aspect ratio holes in circuit boards and semiconductor devices using a reverse pulse as a means to eliminate the need for levelers and brighteners.

Claims 1-20 and 27-29 are rejected over Dubin et al. in view of Martin et al.. Dubin et al. is cited relative to claims 27-29 as teaching a plating bath containing copper, sulfuric acid, chloride ions, and a suppressing agent such as PEG. The applicant submits that Dubin et al. does not remedy the basic defects in the teachings of Martin et al. relative to levelers and brighteners. In this regard, the applicants submit that a person of ordinary skill in the art would not be led to use the Dubin et al. bath in conjunction with the teachings of Martin et al. The applicants submit that there are a myriad of electroplating baths available in the art and in making the rejection, the Office has not identified any teaching in Dubin et al. that would necessarily lead a person skilled in the art to use these particular baths in conjunction with the teachings of Martin et al. Additionally, Dubin et al. does not expressly exclude the use of levelers and brighteners.

More particularly, the invention resides not in the use of the Dubin et al. bath but rather in the applicant's discovery that features having a high aspect ratio can be plated effectively without using levelers or brighteners if the reverse pulse method is used. Regardless of the availability of the Dubin et al. bath, a person of ordinary skill in the art would assume that the most effective way to coat high aspect ratio features requires the use of levelers or brighteners for the reasons noted in Dr. Taylor's affidavit. Dr. Taylor has discovered that these additives that have historically been used particularly with the more difficult or more demanding electroplating methods, can be omitted if the reverse pulse method is used. For this reason, the rejection over Dubin et al. in view of Martin et al. should be withdrawn.

Claims 28 and 29 are rejected over Martin et al., Barstad, or Anthony in view of Chen. The Office contends that Chen teaches a plating bath without levelers or brighteners and that Chen would lead a person of ordinary skill in the art to modify the principal references in this regard. The applicants vigorously disagree. The applicants submit that there is no teaching in Chen that would lead a person of ordinary skill to adopt this particular teaching with respect to

electroplating holes and recesses having high aspect ratios using the claimed current conditions. Specifically, Chen addresses the formation of ultra-thin metal seed layers. The formation of these seed layers does not involve parallel considerations to plating high aspect ratio throughholes and cavities. At paragraph 16 of the Office Action, the Office cites teachings in the Chen reference to the effect that organic additives may be used to produce better film characteristics and better filling. This teaching clearly does not suggest that levelers and brighteners should be eliminated. To the contrary, this teaching merely reflects the well known use of brighteners and levelers in the art.

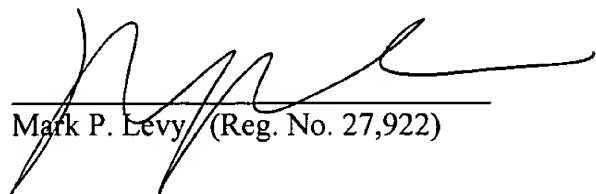
The applicant submits, that his invention resides in the use of pulsed reversed current to plate holes and recesses having high aspect ratios and his discovery that this process can be conducted effectively without brighteners and levelers that can introduce cost and variables that historically have made conventional processes less reliable. This discovery is not suggested by Martin et al. taken alone or in combination with the secondary references.

At paragraphs 10 of the Official Action the claims are rejected for double patenting. Attached is a terminal disclaimer that obviates this issue.

In view of the foregoing arguments, the rejections should be withdrawn and this case should be passed to issue.

Favorable action on the merits is requested.

Respectfully submitted,



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